Historic, archived document

Do not assume content reflects current scientific knowledge, policies, or practices.

A 280.39
M 34Am
Cop. 2

AMS-517

Effect of Hot Water Treatments and Hydrocooling on Postharvest Bacterial Soft Rot in

BELL PEPPERS

U. S. DEPT. OF AGRICULTURE
NATIONAL AGRICULTURAL LIBRARY
JUL 21 1964
CURRENT SERIAL RECORDS

UNITED STATES DEPARTMENT OF AGRICULTURE
Agricultural Marketing Service
Market Quality Research Division

WARNING

Streptomycin nitrate, used in these tests for experimental purposes, should not be used commercially to control bacterial soft rot on bell peppers. It has not been approved by the Food and Drug Administration as a postharvest dip for fresh fruits and vegetables.

Washington, D.C. April 1964

EFFECT OF HOT WATER TREATMENTS AND HYDROCOOLING ON POSTHARVEST BACTERIAL SOFT ROT IN BELL PEPPERS

By Howard B. Johnson, senior plant pathologist
Horticultural Crops Branch,
Market Quality Research Division,
Agricultural Marketing Service

SUMMARY

Hot water reduced decay in bell peppers that had been inoculated with bacterial soft rot 15 to 24 hours before treatment. Hot water treatments in order of their effectiveness were 128° F. for 1-1/2 minutes, 123° for 2-1/2 minutes, and 133° for 3/4 minute. Additional tests for injury with treatment the same day as harvest are necessary before hot water treatments can be recommended for commercial use. Hydrocooling after application of decay control treatments resulted in greater decay in inoculated peppers.

INTRODUCTION

Bacterial soft rot (Erwinia carotovora (L. R. Jones) Holland, and other bacteria) is the most destructive postharvest decay of Texas-grown bell peppers. The causal bacteria are found in the soil wherever peppers are grown. Although the decay is usually first observed after the shipment has reached a destination point, the primary infection of the fruit occurs during the picking and packing operations.

The soft rot bacteria are wound-parasites. Broken stem tissues, resulting from harvesting, provide an ideal entry-point for infection following contact either with contaminated soil or picking and packing equipment. The stem and calyx lobe tissues are affected first, followed closely by the pod. The entire fruit can be reduced to a soupy mass within 3 to 6 days after infection if humid conditions and optimum temperatures (75° to 85° F.) prevail.

Refrigeration during transit is commonly used to retard decay and color change in green peppers. Hydrocooling and chemical washes during the packing operation are sometimes used to supplement transit refrigeration for decay control. Immersing the peppers in water during such treatments and packing them while they are damp provides the moisture necessary for infection by bacterial soft rot. Hydrocooling can also reduce pepper temperatures enough to cause pitting injury. Since only a few chemical treatments are approved by the Food and Drug Administration for postharvest use on peppers, effective nonchemical control methods are needed.

Heat treatments to control postharvest decay in some fresh products have been investigated previously. In 1962, Smith[1] reported that hot water treatments reduced decay in peaches that had been inoculated with spores of the fungi causing either brown rot or Rhizopus decay. He listed a number of the earlier investigations, starting with

---

[1] Smith, W. L., Jr. Reduction of Postharvest Brown Rot and Rhizopus Decay of Eastern Peaches With Hot Water. Plant Disease Rptr. 46:861-865. 1962.

Fawcett's[2] in 1922, and commented, "* * * but the results of these tests have mostly been ignored or overlooked."

The results with peaches as reported by Smith prompted the inclusion of hot water treatments in tests with bell peppers. These tests demonstrate the potential value of hot water treatments for the control of bacterial soft rot in peppers.

MATERIALS AND METHODS

Long-stemmed peppers were selected at commercial sheds shortly after delivery from the fields and before washing or waxing. The stems were recut at the laboratory shortly before the peppers were artificially inoculated.

The peppers were arranged with stems up in water-soaked wooden lug-boxes, and each stem was flooded with 1 or 2 drops of inoculum. The inoculum used was a fresh suspension of stem tissues and "soup" from one pepper infected with bacterial soft rot and made up to 100 milliliters with water plus 1 drop of Triton X-100[3](alkylated aryl poly-ether alcohol). The individual boxes containing inoculated peppers were enclosed loosely in polyethylene film and held at 70° F. in high relative humidity for 15 to 24 hours before the peppers were treated for decay control.

Five standard treatments were used; namely, hot water, 123° F. for 2-1/2 minutes, 128° for 1-1/2 minutes, 133° for 3/4 minute; streptomycin nitrate solution (100 p.p.m.) 75° for 1/2 minute; and chlorine solution (250 p.p.m.) 75° for 1/2 minute. The last solution was prepared fresh as needed from a commonly used laundry bleach. Peppers in the check or control lot were dipped in 75° tap water for 1/2 minute.

Streptomycin nitrate and chlorine treatments were included in the test for comparative purposes. The former had given the best control of bacterial soft rot in earlier studies, and the latter is commonly used in postharvest treatments of fruits and vegetables. Streptomycin is not approved by the Food and Drug Administration as a postharvest dip for fresh fruits and vegetables.

A total of 90 peppers in five replications was used with each of the five treatments and one check lot. Paired lots of 20 peppers each were used in two of the five replications. The companion lot was hydrocooled (41° F. for 6 minutes) after the regular treatment. The twice-replicated hydrocooling tests also included uninoculated check lots. No additive was used in the hydrocooler water.

After treatment the peppers were allowed to drain for several minutes, placed in cartons, and held for 6 or 7 days at 70° F. In the two tests in which companion lots were hydrocooled, all peppers were held 3 days at 50° and then 7 days at 70°. In all tests the peppers were subjected to 70° and high relative humidity for 6 or 7 days before the final count of infections.

Triton X-100 was used as a surfactant in all the inoculum suspensions and chlorine solutions. In three tests it was added to all treatments except hydrocooling.

Test peppers used were about evenly divided between the California Wonder and the Yolo varieties.

RESULTS

Decay.--The five treatments are listed in order of their effectiveness against bacterial soft rot in table 1. The percentage of infections obtained in each test lot, the percent of control, and the injury index values are given.

---

[2] Fawcett, H. S. Packing House Control of Brown Rot. Calif. Citrog. 7 (7):232, 254. 1922.

[3] The use of brand names in this report does not constitute endorsement of the products used or imply discrimination against other products.

The elapsed time from inoculation to treatment varied from 15 to 24 hours in different experiments. With the shorter incubation periods most of the peppers showed a water-soaked area on stems (point of inoculation) before the application of treatment. These lesions, typical of bacterial soft rot infection, were present on all peppers at time of treatment in the one test that a 24-hour incubation period was used. In this most severe test the effectiveness of each treatment remained in the same order as shown in table 1. Control ranged from 80 percent with streptomycin down to zero percent with chlorine. The hot water treatments ranged from 35 to 50 percent control.

The results obtained with the three hot water treatments were satisfactory in view of the severity of the test conditions and when compared with the percent of control provided by either streptomycin or chlorine (table 1).

Heat injury.--Treatments in the five tests were applied 24 or 48 hours after harvest. Hot water treatments resulted in slight to moderate pitting injury to some peppers in the two tests in which treatment applications were 24 hours after harvest (table 1). No injury occurred in the other tests in which treatments were delayed until 48 hours after harvest. The long 15- to 24-hour incubation period after inoculation, used in tests to date, precluded treatments the same day the peppers were harvested.

TABLE 1.--Control of bacterial soft rot in inoculated bell peppers by hot water and other treatments listed in order of effectiveness, and final injury index

Treatment	Delay after inoculation (hr. at 70° F.)	Infections after days at 70° F.		Final control[1]	Final injury index[2]
		2 or 3	6 or 7		
		Percent	Percent	Percent	
Streptomycin (100 p.p.m.) Dip: 75° F. - 1/2 min........	15 to 24	10.0	15.7	78.6	0
Hot water Dip: 128° - 1-1/2 min........	do	14.4	19.3	73.7	.66
Hot water Dip: 123° - 2-1/2 min........	do	17.7	20.0	72.7	.38
Hot water Dip: 133° - 3/4 min..........	do	25.5	32.2	56.1	.35
Chlorine (250 p.p.m.) Dip: 75° - 1/2 min...........	do	51.1	59.1	19.4	0
Check (tap water) Dip 75° - 1/2 min............	do	67.7	73.3	-	-

[1] Compared with percent infections in inoculated check lot. x = percent of peppers infected in check lot; y = percent of peppers infected in treated lot; $\frac{x-y}{x} \times 100$ = percent control by treatment.

[2] Includes only two tests in which injury occurred in lots treated with hot water. Index based on scale of 0-3 in which 0 = no injury; 1 = slight surface pitting, scarcely visible; 2 = moderate pitting; 3 = severe.

Hydrocooling.--For convenience the treatments are listed in table 2 in the same order as in table 1. The percentage of positive infections and control are given for the paired lots of each treatment, one of which was nonhydrocooled and one hydrocooled. Hydrocooling caused increases in the percentage of infections in all tests in which inoculated peppers were used (table 2). The increases in percentage were evident after peppers were held 3 days at 50° F., and the percentages increased greatly with 7 days additional storage at 70°. The percent of control was reduced in all hydrocooled lots except in the chlorine treatment.

Among the paired lots of uninoculated peppers (table 2) the "dry-no dip" lot showed the lowest percentage of natural infections of bacterial soft rot. Wetting the peppers, in either a tap-water dip or by hydrocooling, resulted in a progressive increase in decay.

TABLE 2.--Effect of hydrocooling on percentage total bacterial soft rot in inoculated and uninoculated bell peppers after 3 days at 50° F. and 7 days at 70°

Treatment	Delay after inoculation (hr. at 70° F.)	Peppers with infections					
		No hydrocooling			Hydrocooling		
		Held 3 days at 50°	Held 7 days at 70°	Final control[1]	Held 3 days at 50°	Held 7 days at 70°	Final control[2]
		Percent	Percent	Percent	Percent	Percent	Percent
Streptomycin (100 p.p.m.) Dip: 75° F. - 1/2 min.....	15 to 20	5.0	23.1	63.0	32.5	62.5	32.3
Hot water Dip: 128° - 1-1/2 min.....	do	7.5	18.9	69.8	10.0	77.7	15.8
Hot water Dip 123° - 2-1/2 min......	do	2.5	17.5	72.0	10.0	72.2	21.8
Hot water Dip: 133° - 3/4 min.......	do	5.0	25.0	60.0	17.5	77.5	16.0
Chlorine (250 p.p.m.) Dip: 75° - 1/2 min........	do	22.5	55.3	11.5	55.0	80.0	13.3
Check (inoculated) Dip: 75° - 1/2 min........	do	42.5	62.5	-	85.0	92.3	-
Check (uninoculated) Dip: 75° - 1/2 min........	-	2.5	25.0	-	7.5	23.1	-
Check (uninoculated) Dry - no dip	-	5.0	5.0	-	10.0	15.0	-

[1] Compared with percent of peppers infected in nonhydrocooled inoculated check lot (Table 1, footnote 1).

[2] Compared with percent of peppers infected in hydrocooled inoculated check lot (Table 1, footnote 1).

DISCUSSION

Treatment of peppers with hot water appears to be an effective and practical method to control bacterial soft rot. Two of the hot water treatments gave control comparable to that with the antibiotic which had given the best control in earlier studies. The least effective hot water treatment was twice as effective as the chlorine wash. Hot water treatments leave no residue. In commercial use recommended times and temperatures could readily be maintained with automatic controls.

Tests for heat injury must be made with peppers treated immediately after harvest before hot water treatments can be recommended for commercial use.

The increase in infections recorded in the hydrocooled peppers suggests that the excess moisture added by the treatment was responsible. Hydrocooling following treatment with an antibiotic or chemical dip would further dilute or remove completely the protective additive from the product. However, this would not be true with peppers following treatment with hot water. Peppers appear dry within minutes after immersion in hot water. The rapid drying following temperatures at or near the thermal death point of the causal organisms probably accounted for the good control of incipient infections of bacterial soft rot by hot water.

U. S. DEPARTMENT OF AGRICULTURE
Agricultural Marketing Service
Washington D. C. 20250
- - -
Official Business

Postage and Fees Paid
U. S. Department of Agriculture